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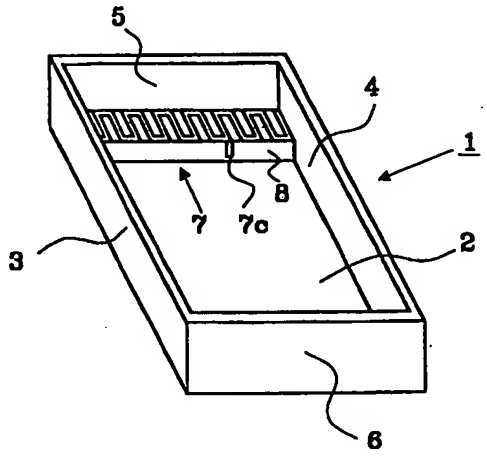
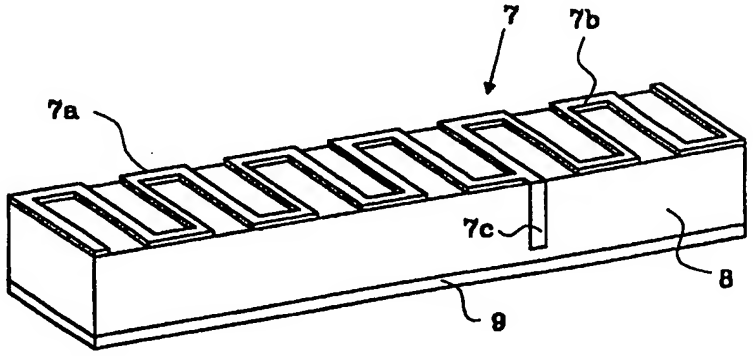
(54) Title: HAND-PORTABLE TELEPHONE WITH RADIATION ABSORBING DEVICE

(57) Abstract

A hand-portable telephone including a casing (1), an antenna device (7) with at least one radiating element (7a, 7b) located in said casing, and a protective device for absorbing a substantial part of the electromagnetic energy being radiated towards the user's head or some other body portion. The device comprises an electrically resistive layer (9) having a surface resistance of at least 25Ω/square.





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HAND-PORTABLE TELEPHONE WITH RADIATION ABSORBING DEVICE

The present invention relates to a hand-portable telephone, including a casing, an antenna device with at least one radiating element, and a protective device for absorbing a substantial part of the electromagnetic energy being radiated from said at least one radiating element towards a human body portion during use of the telephone.

Such protective devices are generally known. Normally, the protective devices are disposed in the vicinity of an antenna rod being extendable from the telephone casing. In the US patent specification 5335366, however, a protective device is disclosed, which comprises a shielding means located inside the casing so as to reflect and/or absorb any electromagnetic radiation generated by the components inside the telephone casing.

The reflecting material is said to be aluminium, other metal, polymer or other suitable material, whereas the absorbing material is said to be lead or some other suitable material. It is mentioned that a material such as lead will present a relatively dense block to the passage of electromagnetic radiation.

However, although lead will effectively absorb electromagnetic radition having very high energy, such as X-rays or γ-rays, lead and similar metal materials will not readily absorb microwaves. The reflective capacity of such devices as disclosed in the US patent specification 5 335 366 mentioned above is also questionable, due to the small dimensions of the reflector structures in relation to the wavelength of the microwave radiation. Therefore, the radiation pattern and intensity will not be significantly altered by these prior art devices. Rather, it is likely that a major part of the radiation directed towards the head of the user will pass around the shielding device.

The main object of the present invention is to provide a hand-portable telephone with a more effective protective device, which will absorb a significant part of the microwave energy being radiated towards the head or some other body portion of the user of the telephone.

Other objects are to provide a protective device which is simple, lightweight and inexpensive. Furthermore, the protective device should be easy to install in the telephone, and it should be reliable even after long use.

The main object stated above is achieved by a protective device comprising an electrically resistive layer, which is disposed at a distance from the radiating element adjacent to a part of the casing being designed to be held adjacent to the human body portion, said electrically resistive layer having a surface resistance of at least 25Ω/square.

As opposed to most of the previously known protective devices, the present invention does not provide a metallic, electrically conductive material serving as a reflector or shielding device. Rather, the inventive concept is to absorb a significant part of the radiation being directed towards the particular human body portion and to transfer the radiation into heat. In hand-portable telephones, the power fed into the radiating element is moderate, and the generated heat will therefore be kept at a relatively low level.

Preferably, the surface resistance of the resistive layer should be 25-800Ω/square, in particular 150-250Ω/square.

Ordinary metal materials have a much lower resistance. However, because of the small skin depth of microwaves into a metal material, the desired surface resistance can be obtained for

very thin metal films having a thickness in the order of 10-100nm, i.e. less than 1μm. Such very thin metal films are commercially available, normally in the form of a metal film deposited on a plastic substrate, e.g. from the Advanced Deposition Technologies, Taunton, Massachusetts, USA.

As an alternative to such a thin metal film, it is possible to use an electrically conducting polymer material, such as polypyrrole. Such materials are also commercially available, e.g. under the registered trademark CONTEX from Milliken & Co.

The electrically resistive layer may be disposed on a support structure mounted inside the casing or it may be disposed on at least one wall defining the casing.

These and other features are stated in the dependent claims and will be apparent from the detailed description below.

The invention will be described more fully below with reference to the appended drawings illustrating a preferred embodiment.

Fig. 1 illustrates schematically, in a perspective view, a cellular telephone casing with an antenna device mounted on a support structure, the rear part of the casing being taken away for clarity;

Fig. 2 shows, likewise in a perspective view, the antenna device and a support structure; and

Fig. 3 illustrates, to a larger scale, the antenna device and its support structure with a protective device according to the invention.

In the drawings, only those parts of the hand-portable cellular telephone are shown, which are essential for understanding the

basic features of the present invention. The rear part and the electronic circuitry inside the casing have been left out in fig. 1.

The casing 1 of the telephone is generally elongated and box-like with a rectangular front wall 2, side walls 3 and 4 and end walls 5 and 6. At the upper end portion of the casing, adjacent to the end wall 5, there is an antenna device 7 mounted on a transverse support bar 8 and including two meander-configured radiating elements 7a and 7b, connected to a common feed point 7c. See also fig. 3. The antenna device is preferably of the kind disclosed in the co-pending patent application entitled "Compact antenna device" filed on the same day by the same applicant. The contents of said co-pending application is incorporated herein by reference.

As is generally known, the meander elements 7a, 7b, when being fed by microwave energy, will emit electromagnetic microwave radiation in virtually all directions. Thus, the cellular telephone can communicate by way of microwave signals to and from a base station irrespective of the orientation of the telephone casing. However, it is inevitable that a substantial portion of the radiated microwave energy will propagate through the front wall 2 and into the head of the person using the telephone.

According to the present invention, a significant part of this radiated energy will be absorbed by an electrically resistive layer 9 (fig. 3) which is disposed at a distance from the radiating element 7 adjacent to the front wall 2 of the casing being designed to be held adjacent to the head of the user. In this embodiment, the resistive layer consists of an extremely thin aluminium film deposited on a plastic substrate, the thickness of the aluminium film being only about 10nm. Such materials are commercially available. Generally, the surface

resistance of the layer 9 should be at least 25Ω/square, and not exceeding 800 Ω/square, preferably between 150 and 250Ω/square.

The supporting bar 8 may be constituted by a hollow thermoplastive material or a foam material, such as Rohacell.

In the embodiment represented by figs. 1 and 3, the electrically resistive layer will be confined only to the relatively small area underneath the antenna device 7. Normally, such a limited extension of the resistive layer is sufficient to obtain the desired result of absorbing a major portion of the microwave radiation directed towards a user's head. However, it is of course possible to extend the resistive layer to the total area of the bottom wall 2, or only a part thereof, where radiation is dominant. One possibility is to apply the layer onto a printed circuit card 10 carrying the support bar 8 and the antenna device 7 and dimensioned to be fitted into the casing 2, as shown in fig. 2.

As indicated above, it is possible to use an electrically conducting polymer material, such as polypyrrole, instead of the thin metal film, provided that the surface resistance falls within the interval 25-800Ω/square.

Any other material having such a surface resistance can of course also be used within the scope of the present invention.

Naturally, the electrically resistive layer can also be disposed directly onto one or more of the walls of the casing, e.g. on the inside, the outside or as an integrated part of the wall. Moreover, the layer may comprise two or more sub-layers provided that the combined surface resistance is at least 25Ω/square so as to effectively convert a significant part of the impinging radiation into heat.

CLAIMS

1. A hand-portable telephone, including a casing (1), an antenna device (7) with at least one radiating element (7a, 7b), and a protective device (9) for absorbing a substantial part of the electromagnetic energy being radiated from said at least one radiating element towards a human body portion during use of the telephone, c h a r a c t e r i z e d i n that said protective device comprises an electrically resistive layer (9), which is disposed at a distance from said radiating element (7a, 7b) adjacent to a part of said casing (1) being designed to be held adjacent to said human body portion, said electrically resistive layer having a surface resistance of at least 25Ω/square.

2. A telephone as defined in claim 1, wherein said electrically resistive layer (9) has a surface resistance of 25 to 800Ω/square.

3. A telephone as defined in claim 2, wherein said electrically resistive layer (9) has a surface resistance of 150 to 250Ω/square.

4. A telephone as defined in any one of claims 1 to 3, wherein said electrically resistive layer (9) comprises a thin metal film.

5. A telephone as defined in claim 4, wherein said thin metal film is deposited on a plastic substrate.

6. A telephone as defined in claim 4 or 5, wherein said thin metal film has a thickness of 10-100 nm.

7. A telephone as defined in any one of claims 4 to 6, wherein said metal film consists substantially of aluminium.

8. A telephone as defined in any one of claims 4 to 6, wherein said metal film consists substantially of zink.

9. A telephone as defined in any one of claims 1 to 3, wherein said resistive layer comprises an electrically conductive polymer material.

10. A telephone as defined in claim 9, wherein said polymer material is polypyrrole.

11. A telephone as defined in any one of claims 1 to 10, wherein said electrically resistive layer is disposed on a support structure (8; 10) mounted inside said casing (1).

12. A telephone as defined in any one of claims 1 to 10, wherein said electrically resistive layer is disposed on the inside of at least one wall defining said casing.

13. A telephone as defined in any one of claims 1 to 10, wherein said electrically resistive layer is integrated with at least one wall defining said casing.

14. A telephone as defined in any one of claims 1 to 10, wherein said electrically resistive layer is disposed on the outside of at least one wall defining said casing.

15. A telephone as defined in any one of the preceding claims, wherein said at least one radiating element (7a, 7b) is located in said casing.

16. A telephone as defined in any one of the preceding claims, wherein said electrically reistive layer comprises at

least two sub-layers, the combined surface resistance being at least 25Ω/square.

Fig. 1

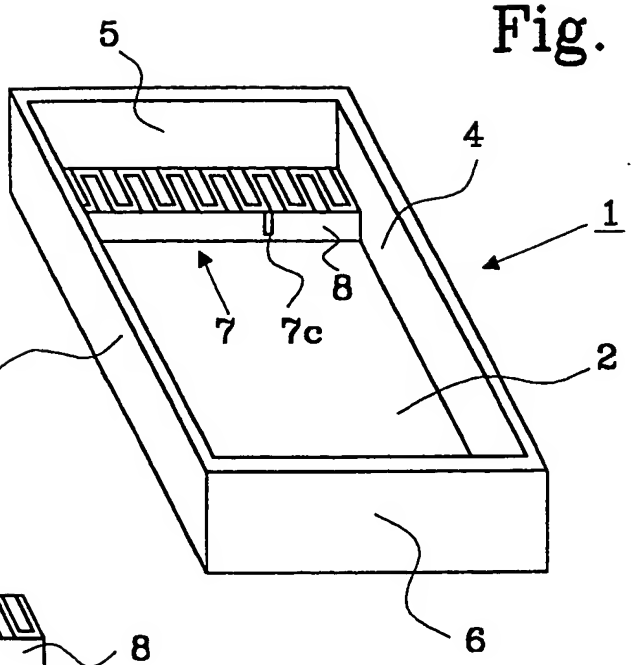
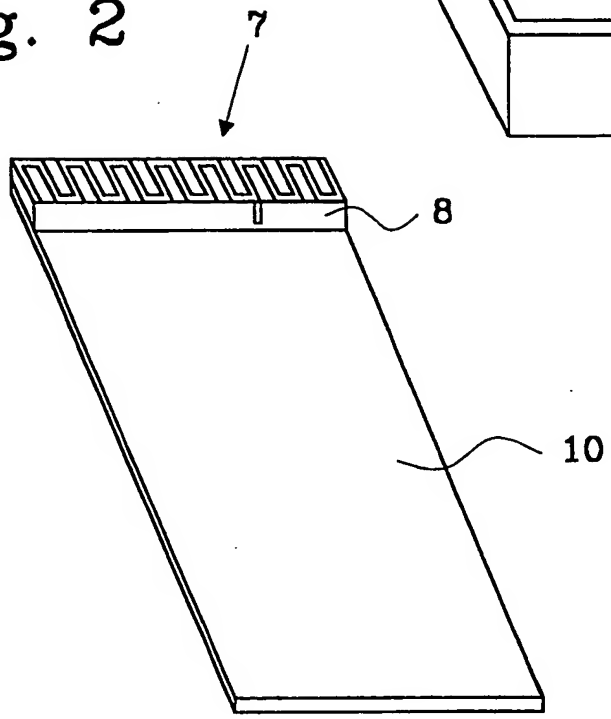


Fig. 2



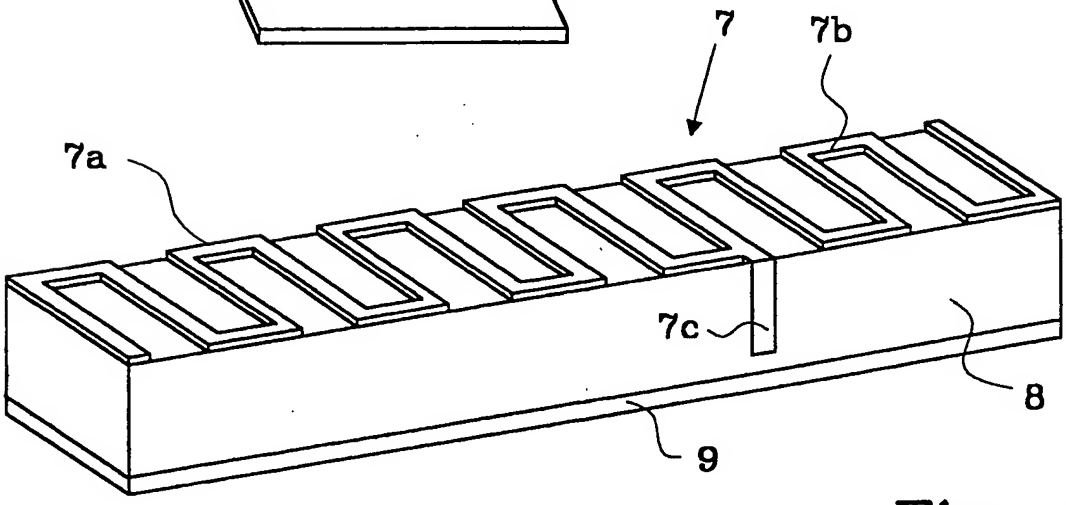


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01272

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01Q 1/24
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0588271 A1 (ALCATEL ITALIA S.P.A.), 23 March 1994 (23.03.94), see the whole document --	1-16
A	DE 1960041 (CHRETIN JEAN), 19 November 1970 (19.11.70), see the whole document --	1-16
A	US 5335366 A (JOHN J. DANIELS), 2 August 1994 (02.08.94), cited in the application -- --------	1-16

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01272

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